DOCUMENT RESUME

ED 331 809 SP 033 040

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TITLE The Effect of Instructional Clarity and Concept Structure on Student Achievement and Perception.
PUB DATE Apr 91
NOTE 58p.; Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, IL, April 2-6, 1991).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Academic Achievement; *Concept Teaching; Higher Education; *Instructional Design; *Instructional Effectiveness; Learning Theories; *Student Reaction; Teacher Effectiveness; Teaching Methods; Undergraduate Students
IDENTIFIERS *Instructional Clarity

ABSTRACT

Instructional clarity is a cluster of instructor behaviors that contains an appropriate use of keys, links, framing statements, focusing, and examples and avoids vagueness terms and mazes. In this study, students' (N=59) achievement and their perception of clear instruction were significantly affected by both the amount of clarity an instructor provided in a classroom presentation and the type of conceptual structuring that was used in a lesson's design. The number of keys, links, framing, focusing, and example moves made by an instructor predicted the amount of achievement that a student would be able to attain in defining, identifying, and applying concepts. Students who were presented with lessons containing more positive instructional clarity moves achieved more. Clear instruction is most beneficial when a variable coordinate concept structure is appropriately used. Achievement of college students is negatively affected by unclear presentations of even well-structured, conceptually presented material. As a concept structure becomes less complex, the amount of instructional clarity becomes less relevant. (IAH)

The Effect of Instructional Clarity and Concept Structure on Student Achievement and Perception

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Paper prepared for presentation
at the annual meeting of the

American Educational Research Association

Chicago
1991

The Effect of Instructional Clarity and Concept Structure on Student Achievement and Perception

Empirical research on effective instruction has suggested that two critical factors contributing to student achievement are (a) clear presentations by instructors (Rosenshine & Furst, 1971; Smith, 1982a), and (b) properly structured concepts (Tennyson & Cocchiarella, 1986). This investigation centered on these two factors and their combined impact on student achievement and student perception of clarity.

Importance of Investigation

This investigation has importance for three reasons. First, as indicated above, the interaction between concept structure and clarity in instruction was addressed. Instructional clarity and concept structure are significant variables in formal instruction. Considerable research has been conducted on each of these variables, however, research on their combined effects is lacking (Hiller, 1971; Land, 1985; Smith, 1982a; Tennyson & Cocchiarella, 1986). Second, this investigation entailed a completely randomized

factorial design and precise operational definitions of the components of clear explanations. Previous instructional clarity studies have used imprecise definitions of clarity and lacked true experimental designs. Third, Tennyson's and Cocchiarella's (1986) model of concept instruction was tested using an enriched and relevant concept in a formal instructional classroom (see Table 1). Researchers they have cited have not compared their complete concept learning strategies. This comparison is significant in understanding the most powerful strategy for presenting concepts.

Insert Table 1 about here

Independent Variables Defined

Rosenshine and Furst's (1971) literature review on effective teaching variables found instructional clarity to be the most important instructor variable influencing student achievement. Previous research on instructor clarity has highlighted either high inference positive instructional clarity moves or low inference negative instructor presentation word arrangements. The current study combined positive and negative low inference instructional clarity moves. It

also focused on how teacher moves (keys, links, framing, focusing, and examples) influence student concept learning.

Positive instructional clarity research by Gliessman, Pugh, Brown, Archer, and Snyder (1989), Cruickshank (1986), and Brown and Armstrong (1984), focused on what an instructor needs to include when preparing a lesson. Negative clarity research by Smith and Land (Land, 1985) focused on what an instructor should avoid when presenting information.

Instructional clarity is a cluster of instructor behaviors that contains an appropriate use of keys, links, framing statements, focusing and examples (Gliessman et al., 1989) and avoids vagueness terms and mazes (Smith, 1982a).

Brown and Armstrong (1984) have related student achievement positively with a high frequency of keys, links, framing, focusing, and examples. Keys are the main ideas or the core elements of a statement. Links logically or structurally relate keys through a hierarchical, sequential, thesis-antithesis, comparative, or problem-centered pattern. Framing refers to statements that set the context for a lesson or explanation. Focusing involves events that serve to center students' attention on keys. Examples

attempt to make ideas, concepts, and principles concrete to the learner.

Vagueness terms are words used in presentations that distract or only give a general idea of a more specific concept. In five experimentally designed studies that investigated the negative effects of vagueness terms on student achievement, the number of vagueness terms per minute was given (Land and Smith, 1979a; 1979b; Smith and Bramblett, 1961; Smith and Cotten, 1980; Smith and Edmonds, 1978). When more than 7.2 vagueness terms were given per minute, student achievement and the perception of lesson clarity was negatively affected.

Mazes are communication patterns that do not make semantic sense (Hunt, 1968). Mazes can be false starts, halts in speech, redundantly spoken words, or false starts in communication (Smith, 1977). In two experimentally designed studies (Smith and Land, 1979a; Smith and Land, 1980), it was found that when mazes occurred at a rate of 5.1 per minute, a negative effect was created on achievement and student's perception of instructional clarity. When Land and Smith (1979b) used 7.5 vagueness terms and mazes per minute, and Land (1981b) used 6.76 vagueness terms and

mazes per minute in lessons, student achievement was also negatively affected.

Tennyson and Cocchiarella contend that the instructor who is effective at teaching concepts needs to determine if the concept being addressed should be presented in succession or in coordination with the other concepts. This decision process is based on research that has indicated three types of classification errors: (a) overgeneralization, (b) undergeneralization, and (c) misconception (Tennyson, Woolley, and Merrill, 1972).

If concepts need to be generalized only within their concept class, then a successive (outline) presentation of the concepts is most appropriate. If concepts need to be generalized within their concept class and discriminated from other concept classes, then a coordinate (simultaneous) presentation of the concepts should be used. The second content analysis decision concerns the stability of the concept being taught. Concepts that have constant dimensions across contexts should be taught differently than concepts that have variable dimensions across contexts.

The current study had two independent variables, instructional clarity and concept structure. Instructional clarity had two levels, clear and

unclear. Concept structure had three levels. The first, a variable coordinate concept structure, stressed examples, critical attributes, gave strategy knowledge for categorizing concepts, elaborated on attributes, and gave a context for the problem domains to which a concept can be applied. The second, a constant successive concept structure, stressed the use of examples in instruction and also gave the concept attributes. The third, a classical attribute concept structure, stressed teaching important attribute distinctions between related concepts.

Dependent Variables Defined

The five dependent variables in this investigation were measures of concept learning based on Stones's (1979) model. The first variable, definition knowledge, required students to recall a complete definition of the concepts being taught.

The second, third, and fourth variables required students to identify examples, nonexamples, and key words in examples that helped them identify concepts in a novel situation. The fifth variable, application, required students to apply the concepts they had learned to a given context.

Hypotheses of Investigation

Sets of hypotheses about the impact of instructional clarity and concept structuring on student achievement were constructed.

Hypothesis Set 1

A clearly presented variable coordinate concept structured lesson (Clear/Var./Coord.) will generate higher achievement scores than an unclear lesson with the same concept structure (Unclear,Var./Coord.) and clearly presented lessons with a constant successive (Clear/Con./Succes.) or classical attribute concept structure (Clear/Clas./Attri.).

Hypothesis Set 2

Unclear instruction will negatively affect the potency of the variable coordinate concept structure (Unclear/Var./Coord.). The unclear variable coordinate concept group will achieve less than the more simple concept structures (i.e., Unclear/Con./Succes.; Unclear/Clas./Attri.).

Hypothesis Set 3

A clear constant successive (Clear/Con./Succes.) concept structured lesson will result in higher student achievement than either an unclear constant successive (Unclear/Con./Succes.) concept structured lesson or a clear classical attribute (Clear/Clas./Attri.) concept structure.

Two hypotheses were proposed concerning about how students would perceive lessons given with different types of instructional clarity and concept structure.

Hypothesis 1

Students will be able to perceive a difference in the clarity of the lessons presented.

Hypothesis 2

Students will perceive a difference in the clarity of a presentation when concept structures differed and the type of clarity was held constant.

It was also hypothesized that there would be a correlation between individual instructional clarity moves and student achievement.

Hypothesis

Positive instructor moves (e.g., keys, links, framing, focusing, and examples) as perceived by students will have a positive, significant correlation with each measure of student achievement.

Method

Subjects

The subjects in the investigation were 59 undergraduate students randomly assigned to six treatment groups. The subjects were taken from an introductory psychology class and each received a grade for participating.

Research Design

A 2 x 3 completely randomized factorial design was used to assess the effects of instructional clarity and concept structure when a coordinate

variable type of concept was taught (see Table 2). There was a clear and unclear level of instructional clarity. The clearly taught groups received a higher frequency of positive instructional clarity moves and a lower number of vagueness terms and mazes than the unclear groups. A variable coordinate concept structure, a constant successive concept structure, and a classical attribute concept structure were used to test the importance of the structure of information being taught.

Insert Table 2 about here

Specifications of Positive and Negative Clarity for Experimental Design

The clear lessons had an absence of mazes and vagueness terms while using, on the average, 17 to 18 positive clarity moves. The unclear lessons were rewritten so that five mazes and five vagueness terms were included for every minute of instruction per pages of script. These unclear lessons also contained approximately 13 fewer keys, links, focusing, framing, and example moves than the clear lessons (see Table 3).

Insert Table 3 about here

Structure and Order of Concepts in Experimental Design

There were three types of conceptual structures used in the experiment (see Table 4). Tennyson's and Cocchiarella's (1986) concept learning model predicted that the variable coordinate concept strategy was the most appropriate strategy for instructing a variable coordinate concept. This instructional strategy allowed for appropriate generalizations within a concept and appropriate discrimination from other concepts.

Insert Table 4 about here

The second type of conceptual structure is referred to by Tennyson and Cocchiarella (1986) as a constant successive concept structure. They have predicted that this instructional strategy for structuring concepts will not result in the maximum student achievement when the concept is used in different contexts and needs to be discriminated from

other concepts as well as generalized within its own concept class.

The third type of instructional strategy for structuring concepts that was utilized was a classical attribute structure. It has been shown to be less effective in contributing to student achievement as a simplified version of the two prior concept structures because it fails to develop a prototype example, does not give expository examples, nor generate interrogatory examples (Dunn, 1983; Park, 1984).

Concept Analysis Decisions for Schedules of Reinforcement

Skinner's concept, schedules of reinforcement, was judged as a variable coordinate concept and was used as the content in the investigation. It is variable due to the high degree of abstraction (perceptibility), complex rule structure (complexity), and multiple dimensions (dimensionality). It is a coordinate concept because the concepts within it need to be generalized within the concept class and discriminated between because of the close resemblance of the schedules (Snyder, 1991).

Procedure

Six scripted videotapes were constructed to reflect the training and control groups discussed in

the research design section of this paper. These videos were produced with only one instructor. The voice of the instructor and continuous visual input in the form of printed material constituted the information conveyed on the videotapes. These procedures were performed to achieve maximum control over instructor and content variables. Taveggia's (1974) review of the literature revealed that there was no significant difference in student achievement when using videotaped lessons as opposed to face to face instruction.

Each of the six groups were tested on the same day and at the same time. The groups received a standard set of instructions before seeing the videotape. The instructions gave the order in which materials would be given and indicated how long the students would have to complete them. They were told that the video was a tool for learning the schedules of reinforcement and were reminded that they would be tested on the material. Each of the groups received 45 minutes of instruction, 10 minutes for reviewing their notes, and 30 minutes of testing (see Table 5). Two questionnaires were given to be completed in about 10 minutes followed by a 10 minute review session and then a 30 minute concept test. The three Likert-type

questionnaires consisted of a 20-item Clarity of Teaching instrument, and a 13-item Lesson Evaluation Form-Clarity questionnaire. The instructional time was longer than previous studies on clarity (Land & Smith, 1979a; Land & Smith, 1979b; Smith & Bramblett, 1981) to reflect an actual classroom presentation.

Insert Table 5 about here

Grading of Concept Achievement Test

The three sections of the concept test were graded separately. The definition section was worth 60 points. Students were given two points for each of the five schedules of reinforcement when they correctly identified: (a) the label of the concept, (b) whether the schedule maintains or develops a response, (c) whether the concept dealt with time or number, (d) whether the schedule dealt with fixed or variable rewards, (e) the type of rest period the concept provides, and (f) the rate of response each of the schedules creates.

The identification section had three dependent variables associated with it. The first, identifying the correct reinforcement schedule, was worth 20 points. Second, identifying key words that helped the

students determine the proper schedule, was worth a possible fifty-six points. The third dependent variable was identifying the nonexamples, worth 6 points. The scoring for each of these dependent variables was objectively determined before the test was given.

The application section was worth 60 points. No points were awarded: (a) if a definition was given, (b) if the example did not fit the category given to the student to use, or (c) if labels were imprecise. Points were awarded if they met the same criteria (a-f) as mentioned in the definition section.

Results

Student Achievement

Hypothesis set 1

Using the Dunn-Sidak multiple comparison test, the Clear/Var./Coord. concept group achieved significantly better than students who received an unclear presentation with the same concept structure (Unclear/Var./Coord.). This achievement difference held true on the definition ($p<.01$), identification of examples of the concept taught ($p<.01$), finding key words in identifying example problems ($p<.01$), the identification of nonexamples ($p<.05$), and the application ($p<.01$) sections of the achievement test.

The results indicate that instructional clarity is a powerful variable in promoting learning when students are given the best type of concept teaching, according to Tennyson and Cocchiarella (1986) (see Table 6).

Insert Table 6 about here

A simple main effects test was conducted to compare clearly taught lessons with different concept structures. There was a significant difference in achievement in defining concepts between the variable coordinate, constant successive, and classical attribute concept structure groups when lessons were clear, ($F(2,53)=6.54$, $p<.01$). The variable coordinate group did significantly better than both the constant successive ($p<.05$) and the classical attribute concept ($p<.05$) structure groups for clear lessons. There was no significant difference in definitional achievement between the constant successive and classical attribute concept structure groups when lessons were presented clearly ($p>.1$).

The simple main effects tests conducted on student achievement for identifying examples of concepts ($F(2,53)=.70$, $p>.1$) and identifying nonexamples ($F(2,53)=.35$, $p>1$) showed no significant

difference between concept structure groups for clear presentations.

The concept structure of a clear lesson was important if students were asked to apply the concept they had learned ($F(2,53)=8.36, p<.01$). When Dunn-Sidak tests were conducted, there was no significant difference in achievement between the variable coordinate and the successive variable groups ($p>.1$). A difference was found between the successive constant and the classical attribute concept groups ($p<.01$). These results suggest that when students apply clearly communicated content, a variable coordinate or constant successive concept structure is most effective.

Hypothesis set 2

Simple main effect tests were conducted on the effects of unclear lessons on variable coordinate, constant successive, and classical attribute concept structures. Significant differences were not found for identifying key words in examples ($F(2,53)=1.80, p>,1$), and identifying nonexamples ($F(2,53)=2.24, p>.05$). The three concept structure groups for unclear lessons did differ when students were asked to define the concepts learned ($F(2,53)=2.38, p<.05$), identify examples of the

concepts ($\underline{F}(2,53)=3.59, p<.01$), and apply the information gained from instruction, ($\underline{F}(2,53)=22.11, p<.01$).

Dunn-Sidak tests compared the effects of unclear lessons and concept structuring on students' ability to remember definitions of the concepts taught. There were no significant differences ($p>.1$).

Students' ability to identify examples of the concepts learned when lessons were unclear and different concept structures were used was investigated using the Dunn-Sidak tests. The classical attribute group did significantly better than the variable coordinate group ($p<.05$). There were no other significant differences between concept groups when the information was presented unclearly ($p>.1$). It seems that when information is presented unclearly a more complex concept structure will lessen students' ability to identify the concepts taught. The successive constant concept structure did significantly better than either the coordinate variable ($p<.01$) or the classical attribute ($p<.01$) concept structured approach.

<u>Hypothesis set 3</u>

A Dunn-Sidak test indicated that the clear and unclear lessons did not create a significant

difference in student achievement. This finding held true whether students were asked to define ($p>.1$), identify examples ($p>.05$), identify key words in examples ($p>.1$), identify nonexamples ($p>.1$), or apply ($p>.1$) the concepts that were learned.

There was a significant difference in student achievement when students were asked to apply concepts they learned ($p<.05$). There were no significant differences between these two groups when student achievement was measured by asking the student to define ($p>.1$), identify examples ($p>.1$), point out key words in the examples ($p>.1$) and identify nonexamples ($p>.1$).

When a lesson was delivered using a classical attribute concept structure, the lesson's clarity made little difference in students' achievement. There were no significant differences between the clear and unclear lessons in the students' ability to define concepts ($p>.1$), identify examples ($p>.1$), and identify key words in examples ($p>.05$).

The clarity of the lesson did affect information presented in a classical attribute structure when students were asked to identify nonexamples ($p<.1$) and apply concepts taught ($p<.01$).

Main Effect Results

The main effects of the experiment will be discussed under the structure of the five dependent variables which were used. The ANOVA for students' ability to define the concepts taught was conducted for instructional clarity and concept structuring. There was an interaction between instructional clarity and concept structuring ($F(2,53)=8.38, p<.001$). There was also a significant difference for instructional clarity ($F(1,53)17.08, p<.001$) but not for concept structure ($F=(2,53)=.50, p>.1$). Instructional clarity accounted for 44% of the controlled score variance. The interaction accounted for another 44% of the score variance.

The main effects of the ANOVA conducted on instructional clarity and concept structure for students' ability to identify examples of concepts was significant for instructional clarity ($F(1,53)=20.47, p<.001$) but not for concept structure ($F(2,53)=.94, p>.1$), nor interaction effects ($F(2,53)=.3.04, p>.05$). Instructional clarity accounted for 50% of the score variance.

An ANOVA was conducted on instructional clarity and concept structuring for students' ability to identify key words that would help them identify

examples of concepts taught. There was a significant difference for instructional clarity ($F(1,53)=26.97, p<.001$) but neither the concept structure ($F(2,53)=.19, p>.1$) nor an interaction between the two variables was significant ($F(2,53)=2.30, p>.1$). Instructional clarity alone accounted for 57% of the score variance.

The main effects for the ANOVA measuring identification of nonexamples indicated significance for instructional clarity ($F(1,53)=21.01, p<.001$). There was not a significant difference for concept learning ($F(1,53)=2.19, p>.1$) or an interaction between clarity in instruction and concept structure ($F(1.53)=.45, p>.1$). Instructional clarity accounted for 52% of the score variance.

The main effects for the application section of the student achievement test showed a significant interaction between instructional clarity and concept structure ($F(2,53)=13.26, p<.001$). There were significant main effects for instructional clarity ($F(1,53)=41.77, p<.001$) and also for concept structure ($F(2,53)=17.39, p<.001$). The interaction accounted for 41% of the score variance, instructional clarity accounted for 52% of the score variance, and concept structure accounted for 47% of the score variance.

Student Perception

Hypothesis 1

The main effects of the ANOVA for the Clarity of Teaching questionnaire were significant for instructor clarity ($F(1,53)=132.87, p<.001$). A Dunn-Sidak test indicated that the clear and unclear groups were differentiated when a variable coordinate ($p<.01$), constant successive ($p<.01$), or a classical attribute ($p<.01$) concept structure was used.

The main effects of the ANOVA for the Lesson Evaluation Form-Clarity questionnaire were significant for instructional clarity ($F(1,53)=224.28,, p<.001$). It was found that students perceived the clear and unclear groups as significantly different from each other in clarity for all concept structures ($p<.01$). It seems that students can recognize the clarity of lessons regardless of concept structure (see Table 7).

Insert Table 7 about here

Hypothesis 2

The ANOVA for the Clarity of Teacher questionnaire indicated that there was a significant difference in how students viewed the clarity of a presentation for the three different types of concept structures ($F(2,53)=p<.001$). A simple main effects

test showed a significant difference between all three concept structure groups when they were presented in a clear fashion ($F(2,53)=8.34, p<.001$). A simple main effects test for the three unclear concept structure groups showed no significant differences ($F(2,53)=1.83, p>.1$).

An ANOVA for clarity in teaching and concept structure, as measured by the Lesson Evaluation Form-Clarity questionnaire showed that students perceived a difference in clarity ($F(1,53)=224.28, p<.001$). A simple main effects on the three different clear concept structured lessons were significant ($F=(2,53)=3.36, p<.05$). A Dunn-Sidak test indicated perceptual differences for clear lessons existed between the variable coordinate and classical attribute concept structure ($p<.05$). There were no significant differences between the variable coordinate and the constant successive concept structure groups ($p>.1$).

The simple main effects for perceived clarity differences in the unclear concept structured lessons showed no significant differences ($F(2,53)=2.50, p>.05$).

Correlations Between Instructional Clarity Moves and Student Achievement

Hypothesis 1

It was hypothesized that each of the positive instructional clarity moves as perceived by the students would have a positive significant correlation with each measure of student achievement. Student achievement on the definition section of the concept test had a positive significant relationship to the inclusion of keys ($r(57)=.53, p<.001$), links ($r(57)=.35, p<.01$), frames ($r(57)=.25, p<.05$), focusing moves ($r(57)=.33, p<.01$), and examples ($r(57)=.35, p<.01$) in the lessons.

Each of the positive clarity moves also had a positive significant correlation with the ability to identify novel examples of the concepts learned. The use of keys ($r(57)=.50, p<.001$), links ($r(57)=.41, p<.001$), frames ($r(57)=.26, p<.05$), focusing moves ($r(57)=.50, p<.001$), and examples ($r(57)=.32, p<.01$) by an instructor were each positively related to the students' ability to identify examples.

Lessons containing a greater number of positive instructional clarity moves related positively to the ability to identify key words in novel examples of the

concepts taught. The inclusion of keys ($r(57)=.43, p<.001$), links ($r(57)=.41, p<.001$), frames ($r(57)=.39, p<.001$), focusing moves ($r(57)=.46, p<.001$) and examples ($r(57)=36, p<.01$) were all related to student performance.

Lessons that included a greater number of keys ($r(57)=.51, p<.001$), links ($r(57)=.51, p<.001$), focusing moves ($r(57)=.49, p<.001$) and examples ($r(57)=.42, p<.001$) were positively related to the students' ability to identify nonexamples.

The ability to apply the concepts that were taught had a positive and significant relationship to the number of keys ($r(57)=.58, p<.001$), links ($r(57)=.40, p<.001$), frames ($r(57)=.33, p<.01$), focusing moves ($r(57)=.44, p<.001$), and examples ($r(57)=.56, p<.001$) that were used in a lesson presentation.

Reliability and Validity of Tests Used

The Lesson Evaluation Form-Clarity and Clarity of Teacher questionnaires were used to assess the perceived clarity of the lessons. The reliability coefficient between these two tests was .85. The Cronbach Alpha for reliability of the Lesson Evaluation Form-Clarity questionnaire was .96. The Cronbach Alpha for the Clarity of Teacher

questionnaire was .96. These high scores for these two questionnaires indicate a high inter-item reliability.

Cronbach Alphas were also conducted for each one of the subscales for the Clarity of Teacher questionnaire. The Cronbach Alphas for these subscales were as follows: (a) keys (.77), (b) links (.92), (c) framing (.78), (d) focusing (.86), and (e) examples (.93). Each of the subscales for the Clarity of Teacher questionnaire demonstrates a fairly high degree of reliability.

The concept test asked students to answer questions in a short answer format. The definition and application sections require judges to rate the answers in a subjective manner. To assess the reliability of the raters that graded the tests, interrater reliability was found. The interrater reliability for the definition section was .99 and the application section was .96.

Validity for the concept test was assessed through an empirical evaluation method. Because there was a significant difference between the control groups and experimental groups, the concept test has content and construct validity.

From the assessments of tests used in this study, the results can be viewed as valid and reliable.

Discussion

College students' achievement and perception of clear instruction were significantly affected by both the amount of clarity an instructor provided in a classroom presentation and the type of conceptual structuring that was used in a lesson's design.

Instructional Clarity

One of the main purposes of this investigation was to examine the effects of instructional clarity and concept structure on the conceptual achievement of students. The main effects findings indicated that instructional clarity was a significant component in isolation as well as in combination with concept structure. Instructional clarity was a more powerful design component than concept structure on all dependent variables. The effect size of instructional clarity accounted for approximately half of all the score variance. These results stress the practicality of instructors improving their instructional clarity.

The combined effects of instructional clarity and concept structure were particularly important for defining and applying concepts. The interaction effects accounted for about 40% of the score variance

on these two variables. This indicates the practical significance of planning for a proper use of these two variables in combination when instructing.

Variable coordinate concept structure

As predicted, the Clear/Var./Coord. concept structured group did significantly better on all dependent measures of concept learning than the Unclear/Var./Coord. concept structured group. This indicates that Tennyson's and Cocchiarella's concept learning model (1986) is incomplete in describing what happens when an instructor does not teach clearly. It is important not only that a professor be concerned with making concept structuring moves but also be clear when he/she plans and delivers the information. To be clear, instructors need to provide frequent (18 per page of script) keys, links, focusing, framing, and examples in their presentations. Instructors also need to avoid the use of vague terms and mazes in their delivery of content.

College students were able to perceive a difference in the clarity of the variable coordinate conceptually structured lessons taught as predicted. The ability of college students to perceive the clarity of a lesson is consistent with previous research on negative low inference elements of clarity

(Land & Smith, 1979a; Smith & Land, 1980; Land, 1981a; Land, 1981b; and Land & Smith, 1981).

Clear presentations by instructors are extremely important when a complex concept structure such as the variable coordinate concept structure is employed. The clarity of a variable coordinate concept structure is important to student achievement and perceived clarity satisfaction of college students.

Constant successive concept structure

The clarity of a lesson presentation does not seem to be a significant variable affecting student achievement when a constant successive concept structure is given. Even though students receiving the clear lesson for the constant successive concept structure did better than the unclear lesson on all the dependent measures, there was no statistically significant difference found. This finding does not support the original hypothesis that the Clear/Con./Succes. concept structured lesson would do better than the Unclear/Con./Succes. concept structured lesson. A possible hypothesis for this finding might be that, as the complexity of a lesson's concept structure is decreased, students are better able to sort through the instructor's unclear presentation to understand the content given.

Even though there was not a significant difference in the achievement of college students between the Clear/Con./Succes. and the Unclear/Con./Succes. concept structured groups, students perceived a difference in clarity between the two lessons. It seems that the satisfaction students gain from a lesson presentation is more sensitive than the achievement of students.

Classical attribute concept structure

Student achievement and perception of the lesson's clarity were affected by the clarity moves presented when an instructor taught a concept with a classical attribute concept structure as predicted. There was a significant difference in achievement between the Clear/Clas./Attri. and Unclear/Clas./Attri. concept structured lessons when students were asked to identify non-examples or apply the concept presented. Since the classical attribute concept structure was designed to represent the traditional method for teaching concepts (Park, 1984), it seems that students' achievement is affected by the clarity of a lesson in the traditional classroom.

If instructors want students to apply information, the clarity of their presentation is important. It is hypothesized that providing frames

and links for concepts gives additional information to the student that benefits conceptual understanding. Both links and frames help students distinguish between concepts.

Students were able to distinguish between the clear and unclear lessons that were structured conceptually in a classical attribute manner. This finding suggests that students are accurate in their evaluation of the amount of clarity that an instructor demonstrates in a presentation. It seems that students were able to detect the amount of clarity an instructor in a traditional classroom is able to generate in a presentation.

Individual Clarity Moves in Instruction

Each of the positive instructional clarity moves, as perceived by students receiving instruction, had a positive significant correlation with each measure of student achievement as hypothesized. The number of keys, links, framing, focusing, and example moves made by an instructor predicted the amount of achievement that a student would be able to attain in defining, identifying, and applying concepts. Students who were presented with lessons containing more positive instructional clarity moves achieved more.

These data suggest that all the positive

instructional clarity moves are important in training teachers to become more clear in their presentations. These results are supportive of previous research by Brown and Armstrong (1984). Further research needs to be conducted to investigate whether a causal relationship exists for each of these instructional clarity moves individually. This type of research would help supervising teachers or beginning professors know what elements of instructional clarity to stress to present information more clearly.

Concept Structure

Student achievement

As predicted, the Clear/Var./Coord. concept structured group did significantly better than the Clear/Con./Succes. and the Unclear/Clas./Attri. concept structured groups when students were asked to give complete definitions of the content learned. The Clear/Con./Succes. concept structured group and the Clear/Clas./Attri. concept structured group were not significantly different. The unique features of the Clear/Var./Coord. concept structured group to which the difference in achievement can be attributed are the coordinate (simultaneous) presentation of concepts, giving a context to the material, providing interrogatory examples, elaborating on the content and

providing strategy information for the classification of concepts. These results are consistent with the predictions suggested by Tennyson's and Cocchiarella's (1986) model of concept learning.

In applying information learned about the schedules of reinforcement, there was no sigifnicant difference between the Clear/Var./Coord. and Clear/Con./Succes. concept structured groups. These findings suggest that Tennyson's and Cocchiarella's (1986) concept learning model is not adequate to deal with all levels of knowledge comprehension. The Clear/Var./Coord. and Clear/Clas./Succes. concept structured groups both did better than the Clear/Clas./Attri. concept structured group. These results indicate the importance of giving examples (i.e., best and expository) if information is to be applied effectively. The function of best and expository examples is complimentary. The best example provides a prototypical form of the concept. An expository example provides richness to conceptual knowledge begun by giving a best example. Tennyson and Cocchiarella (1986) contend that expository examples help in both the development of conceptual knowledge by giving more dimensions of a concept and providing a transition between conceptual and

procedural knowledge. This finding supports the conclusion made by Dunn (1983) and Park (1984) that the classical attribute model is inferior to an exemplar model for optimal student achievement.

The Clear/Con./Succes. concept structured lesson resulted in higher application achievement scores than the Clear/Clas./Attri. concept structured group, but not for other dependent measures. The implication of this finding is that the best and expository examples and review of concept qualities of missed examples (embedded refreshment) that are in the Clear/Con./Succes. concept structured lesson but not in the Clear/Clas./Attri. concept structured lesson are important if instructors want students to apply to novel situations. If instructors require students to define or identify concepts taught, a Clear/Con./Succes. or Clear/Clas./Attri. concept structure will be equally as effective.

Student perception

College students perceived a difference in clarity among the three different types of concept structures when clear lessons were given, but not when unclear lessons were used. The differences in perception were found only between the

clear/Var./Coord. and the Clear/Clas./Attri. concept structured lessons.

The reason this difference in clarity lies between the two concept structures may be that the combined effect of multiple examples, strategy information, attribute elaboration, embedded refreshment, and a simultaneous presentation of concepts enhances the clarity of information.

By itself, focusing on structuring concepts is not enough to make a lesson clear. This statement is supported by the unclear ratings that students gave the unclear presentation even though different concept structures were used. It is further supported by the insignificant differences in the unclear lessons using the three different concept structures. It seems that when information is not communicated clearly, students do not judge different concept structures clearer than others. Again, it must be maintained that instructional clarity is enhanced only by a more sophisticated concept structure when concepts are communicated with positive clarity and a lack of negative clarity.

If a presentation was clear and the student evaluation demanded an understanding of how to apply concepts, then a variable coordinate and constant

successive concept structure were superior to a classical attribute concept structure. This indicates that in order to apply concepts that are presented clearly, concept structures need to contain best examples, expository examples, and embedded refreshment, along with complete definitions. This supports the use of an exemplar concept learning model in helping students apply concepts. These findings suggest that Tennyson's and Cocchiarella's concept model is adequate to explain the effects of instructional clarity on the application of students' knowledge.

Future Research

Areas for future research will be addressed by looking at questions involving the following; (a) instructional clarity, (b) concept structure, (c) the combined effect of instructional clarity and concept structure.

Instructional clarity

The results of this study have shown that there is a positive significant relationship between student achievement and a high frequency of keys, links, focusing, framing statements, and examples. From this correlational evidence, several causal questions might be asked. Are all of the elements of positive

instructional clarity necessary for students to achieve optimally? Are some of the positive instructional clarity moves more at the core of what instructional clarity is?

From retrospective reports of what students believe clear instructors do (Kennedy, Cruickshank, Bush & Myers, 1981) other instructional clarity moves, such as questioning, might enhance an instructor's clarity. What qualities of an instructor's presentation are <u>sufficient</u> to describe a clear instructor?

In the present study, the frequency of clarity moves was used as one of the independent variables. Maybe the <u>sequencing</u> of positive instructional clarity moves is more important than the number of instructional clarity moves used. What kind of sequencing of these moves would result in greater student achievement and satisfaction?

The current investigation developed clear and unclear scripts that had a difference of approximately 14 clarity moves per page of script. Further studies need to ask how many positive instructional clarity moves are necessary for the maximum amount of student achievement to occur?

Concept structure

The present study looked at only the achievement of college students when information was structured in different ways. Future research on Tennyson's and Cocchiarella's (1986) concept learning model needs to be conducted on different age groups to determine the age generalizability of the model.

The current research did not consider the developmental sequence of learning a concept. The empirical investigation that was conducted taught a concept that students had little knowledge of to control the knowledge base of the students before the study began. Research needs to be done on the longitudinal effects of having a concept taught several times over an extended period of time. Should concepts be taught differently when students have familiarity with the information?

The present investigation used the concept of schedule of reinforcement. Other concepts might be more effectively learned by a different approach than the one Tennyon and Cocchiarella suggest. If a concept is at a subordinate concept level, should it be taught the same way as one at a basic level or a superordinate concept level? Can superordinate concepts be taught most effectively by Tennyson's and

Cocchiarella's concept learning model's concept analysis questions?

It would be beneficial to study whether student achievement is maintained over a long period of time. Will the differential effects of the way concepts are structured facilitate or inhibit the retention of information over an extended period of time?

Combination effect of instructional clarity and concept structure

One criticism of the results of the present study is that a hypothetical situation was created by forcing some of the experimental groups to receive a low amount of clarity and a sophisticated concept structure. To answer this comment, further research needs to be conducted. One research question could be asked: "When an instructor has prepared a lesson well by evaluating the most appropriate way to structure concepts, will instructional clarity naturally be increased?" A second question could be asked: "When instructors are trained in how to be clear in their presentation, will the way they structure concepts also be more sophisticated?"

A second criticism of the present study might question the operational definition of clarity as functional for performances in an actual classroom.

Instructional clarity was defined as having an absence of vague terms and mazes and an inclusion of a large amount of keys, links, focusing moves, framing moves, and examples. It is possible to reason that if instructors plan for keys, links, focusing, framing, and examples in their presentation that the time in preparation will eliminate vague terms and mazes. If vague terms and mazes are naturally eliminated by including positive instructional clarity moves, why be concerned with them in research? Further research needs to be done to see if training in positive instructional clarity will naturally remove the frequency of vague terms and mazes.

A criticism concerning the methodology of the current study might be the failure to use a live instructor to present the concepts in the study. The current study used scripted videotaped lessons to control for differences in instructors. In future research, a live instructor might be used to teach the concepts in the lesson to increase ecological validity.

Conclusions

Conclusions about instructional clarity, Tennyson's and Cocchiarella's model of concept learning, student perception of instructional clarity,

and correlations between student achievement and instructional clarity moves were made. Three conclusions concern instructional clarity. First, clear instruction is most beneficial when a variable coordinate concept structure is appropriately used. Second, achievement of college students is negatively affected by unclear presentations of even well-structured, conceptually presented material. Third, as a concept structure becomes less complex, the amount of instructional clarity becomes less relevant. Instructional clarity is most important in contributing to advanced levels of student achievement.

Tennyson's and Cocchiarella's concept learning model is accurate for only some conditions when student achievement is assessed. The model is adequate to explain student concept acquisition when information is evaluated through definitions of the concepts learned in clearly taught lessons. It becomes less adequate in predicting optimal student concept acquisition when higher levels of conceptual understanding are required (i.e., identification and application), and when an instructor does not instruct clearly.

The first condition in which their model is inadequate is when instruction is given in an unclear manner, even though Tennyson's and Cocchiarella's hypothesized style of teaching a concept is used. It is also inadequate in explaining why inappropriately taught concept structured groups did equally as well as appropriately taught groups when knowledge was tested at the identification and application levels. Even though the results were not completely supportive of their concept learning model, they were supportive of the exemplar model which is one of the major components of their comprehensive model.

College students seemed to be able to perceive a difference in the clarity of lessons. On both the Clarity of Teaching and the Lesson Evaluation Form-Clarity questionnaires, students were able to discriminate between clear lessons and unclear lessons for all three concept structures. The frequency of positive individual instructional clarity moves predicts the level of student concept achievement.

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Table 1

Instructional Design Strategies for Concept Instruction

Attribute Characteristics	Relational Structure	
	Successive	Coordinate
Constant dimension	Strategy 1	Strategy 2
	Label and definition Best example Expository examples (successive presentation) Interrogatory examples (optional) Embedded refreshment	Labels and definitions Best examples Expository examples (simultaneous presentation) Interrogatory examples Attribute elaboration Embedded Refreshment
Variable dimension	Strategy 3	Strategy 4
	Label and definition Context (problem domain) Bext examples Expository examples (successive presentation) Interrogatory examples Strategy information Embedded refreshment	Labels and definitions Context (problem domain) Best examples Expository examples (simultaneous presentation) Interrogatory examples Attribute elaboration Strategy information Embedded refreshment

Table 2

INSTRUCTIONAL CLARITY AND CONCEPT STRUCTURE DESIGN

Concept Structure	Instructional Clarity — Clear: High Positive Clarity, Low Vagueness	Instructional Clarity — Unclear: Low Positive Clarity, High Vagueness
Coordinate Variable	Training Group #1	Training Group #2
Successive Constant	Training Group #3	Training Group #4
Classical Attribute	Control Group #5	Control Group #6

Table 3 Specifications of Positive and Negative Instructional Clarity Elements in Experimental Design

CLARITY	VARIABLE COORDINATE CONCEPT STRUCTURE		CONSTANT SUCCESSIVE CONCEPT STRUCTURE	CLASSICAL ATTRIBUTE CONCEPT STRUCTURE
CLEAR	POSITIVE CLARITY MOVES			
	Total moves per page	17.50	17.48	16.75
	Keys per page	5.53	5.72	5.75
	Links per page	1.27	.52	1.67
	Focusing per page	8.87	8.20	7.77
	Framing per page	.70	.52	.92
	Example per page	1.13	.68	▶ .00
	NEGATIVE CLARITY MOVES			
	Mazes	0	0	0
	Vague Terms	0	0	0
UNCLEAR	POSITIVE CLARITY MOVES			
	Total moves per page	3.60	3.40	4.25
	Keys per page	2.66	2.15	3.17
	Links per page	.23	.07	.42
	Focusing per page	.10	.11	.50
	Framing per page	.03	.04	.17
	Example per page	.57	1.00	▶ .00
	NEGATIVE CLARITY MOVES			
	Mazes	5/min	5/min	5/min
	Vagueness Terms	5/min	5/min	5/min

Note. ▶ Examples were included in instructional booklets but not in classroom instruction.

Table 4 Structure and Order of Concepts in Experimental Design Concept Structure

CLARITY	VARIABLE COORDINATE	CONSTANT SUCCESSIVE	CLASSICAL ATTRIBUTE
CLEAR			(Parks, 1984)
	Labels and definition	Label and definition	Concept labels
	Context		Attribution of concepts
	Best examples	Best examples	Definition given of concepts with all attributes
	Expository examples (simultaneous presentation)	Expository examples (successive presentation)	Table with comparisons of attributes
	Interrogatory examples		Sub-quesitons for attribute identification
	Attribute elaboration		Given workbook examples to work alone (correct responses given)
	Strategy and information		
	Embedded refreshment	Embedded refreshment	
UNCLEAR			(Parks, 1984)
	Labels and definition	Label and definition	Concept labels
	Context		Attribution of concepts
	Best examples	Best examples	Definition given of concepts with all attributes
	Expository examples (simultaneous presentation)	Expository examples (successive presentation)	Table with comparisons of attributes
	Interrogatory examples		Sub-questions for attribute identification
	Attribute elaboration		Given workbook examples to work alone (correct responses given)
	Strategy and information		
	Embedded refreshment	Embedded refreshment	

Table 5 Order and Time Given for Instruction and Testing

CLARITY	VARIABLE COORDINATE	CONSTANT SUCCESSIVE	CLASSICAL ATTRIBUTE
CLEAR	Clear Coordinate Variable Concept Structure 1. 45 min. video taped instruction 2. 10 min. to give perception questionaires 3. 10 min. review of notes on lesson 4. 30 min. concept test	Clear Successive Constant Concept Structure 1. 35 min. video taped instruction 2. 10 min. instruction booklet of examples on concepts learned 3. 10 min. to give perception questionaires 4. 10 min. review of notes on lesson 5. 30 min. concept test	Clear Classical Attribute Concept Structure 1. 15 min. video taped instruction 2. 30 min. instruction booklet of examples on concepts learned 3. 10 min. to give perception questionaires 4. 10 min. review of notes on lesson 5. 30 min. concept test
UNCLEAR	Unclear Coordinate Variable Concept Structure 1. 45 min. video taped instruction 2. 10 min. to give perception questionaires 3. 10 min. review of notes on lesson 4. 30 min. concept test	A. Unclear Successive Constant Concept Structure 1. 35 min. video taped instruction 2. 10 min. instruction booklet of examples on concepts learned 3. 10 min. to give perception questionaires 4. 10 min. review of notes on lesson 5. 30 min. concept test	Unclear Successive Constant Concept Structure 1. 15 min. video taped instruction 2. 30 min. instruction booklet of examples on concepts learned 3. 10 min. to give perception questionaires 4. 10 min. review of notes on lesson 5. 30 min. concept test

Table 6

Means and Standard Deviations of Achievement Measures for Clarity/Concept Structured Groups

Achievement

		Definitions	Identification of Examples	Keywords in Identifying Examples	Identification of Nonexamples	Applications
Instructional Clarity Clear:						
Concept Structure:						
Variable Coordinate (n=10)	M	41.20	10.40	25.10	1.70	20.00
	SD	16.47	2.80	5.95	1.57	3.53
Constant Successive (n=10)	M	25.00	9.80	22.20	1.90	18.40
	SD	10.59	3.85	2.70	1.60	9.28
Classical Attribute (n=10)	M	24.60	9.10	21.40	1.50	10.50
	SD	12.72	3.28	4.65	.71	2.37
Instructional Clarity Unclear:						
Concept Structure:						
Variable Coordinate (n=10)	M	11.00	3.30	9.30	.30	.50
	SD	9.35	3.27	8.15	.48	1.58
Constant Successive (n=10)	M	20.40	6.40	15.10	1.00	16.40
	SD	8.63	3.20	9.64	.94	7.35
Classical Attribute (n=10)	M	21.56	7.33	14.33	0.00	3.89
	SD	10.67	4.30	10.45	0.00	4.49

Table 7

Means and Standard Deviations of Student Perception for Clarity/Concept Structured Groups

		Perception		
		Concept Structure Questionnaire	Clarity of Teaching	Lesson Evaluation Form-Clarity
Instructional Clarity Clear:				
Concept Structure:				
Variable Coordinate (n=10)	M	40.30	77.00	42.50
	SD	4.27	11.97	4.40
Constant Successive (n=10)	M	35.00	68.40	38.60
	SD	5.44	5.48	3.75
Classical Attribute (n=10)	M	30.50	59.30	37.50
	SD	2.55	13.15	4.70
Instructional Clarity Unclear:				
Concept Structure:				
Variable Coordinate (n=10)	M	28.90	45.20	24.10
	SD	4.98	8.42	5.32
Constant Successive (n=10)	M	26.30	38.70	20.00
	SD	4.17	9.03	4.42
Classical Attribute (n=9)	M	21.56	33.56	21.44
	SD	4.77	7.75	4.45